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THE IMPORTANCE OF COOPERATIVE STUDIES OF THE BIOLOGY OF MAN

By Professor LEE R. DICE

DIRECTOR, LABORATORY OF VERTEBRATE BIOLOGY, UNIVERSITY OF MICHIGAN

MAN is to-day the most studied of animals. He is being investigated by anthropologists, anatomists, physiologists, bacteriologists, parasitologists, pathologists, geneticists, psychologists, psychiatrists, ecologists and other specialists in many sub-branches of the broad field of biology. Most of these investigators are fully competent and the results of their researches are of high value. An increase in the volume of research in every one of these fields would be profitable and very desirable. I venture to suggest, however, that in addition to the studies now being made of man in each of these special divisions of science, it would be highly profitable to study also the whole man in relation to his heredity and to his environment. In making this suggestion I am well aware that numerous investigations of man now in progress or recently completed involve several diverse subdivisions of biology. However, no investigation or group of investigations now in progress is in my opinion sufficiently comprehensive to secure anything like a complete picture of man the animal, as he exists in this constantly changing world.

Every human being is the product of his heredity and of his environment. Arguments about which of the two is the more important are futile, because no group of hereditary factors in sperm or egg can produce an individual organism except through interaction with the environment. Neither can the environment produce any organism without the presence of a group of hereditary factors combined in a reproductive unit of some kind. We can and should, however, measure to the best of our ability the role that each hereditary factor and each feature of the environment plays in the production and maintenance of the individual and of the race and species.

The importance of heredity in the development of

each individual man is attested by the many resemblances in physical characters and in behavior that characterize the members of the same family. The evident differences between some brothers and sisters and other close relatives may in part be due to recombinations of genes and therefore may also to this extent be based on heredity. In fact, we can be sure that all human characters of whatever kind have an ultimate basis in heredity, however much the environment may mold and change the hereditary tendencies.

The characters of man that are inherited include not only his anatomical features, but also his physiology and his psychology. For instance, each of the races of man is distinguished by certain physical characters, but it is recognized by anthropologists that many races also exhibit clearly marked peculiarities of physiology and of psychology. It will of course be admitted that psychological and physiological characters are perhaps somewhat more subject to modification by the environment than are anatomical ones.

The effect of any particular feature of the environment on an organism can only with great difficulty be determined unless the heredity of the organism concerned is known with certainty. It is evident, therefore, that the best method for attack on the problems of human heredity and of environment is to investigate families as groups. Although the heredity of human families will never be as uniform, except in identical twins, as the heredity of the closely inbred strains of laboratory animals, nevertheless certain familial factors can be identified. These hereditary trends within families give a basis for studies of the variations in morphology, physiology and psychology that are produced by environmental influences. The difficulties in carrying out studies of family groups are formidable and the complexities involved are confusing. Nevertheless, this method of attack is in my opinion fully feasible and offers the only possible way of untangling in human affairs the complex interrelations of heredity and environment.

Numerous kinds of genes are known to produce multiple effects both in man and in animals. Thus a gene that produces dislocation of the lens of the eye (*ectopia lentis*) in man also sometimes produces an elongation of the long bones, especially those of the hands and feet, spinal curvature, elongated skull, underdeveloped musculature, infantilism and other abnormalities. This particular multiple effect or syndrome is called arachnodactyly.[1] Some genes that affect the morphology of the body also undoubtedly affect the physiology and psychology of the individual. Unfortunately, we know as yet relatively little about the heredity of these latter kinds of multiple effects.

[1] Harold F. Falls and C. W. Cotterman, 1943, *Arch. Ophthalmology*, 30: 611.

We may even suspect that most or perhaps all genes have multiple effects and that, for instance, a gene which affects mentality probably produces also some definite morphological or physiological effects, if we only knew where to look for them. Here would seem to lie one of the most important practical values of comprehensive and coordinated studies of man. If we can identify a gene that produces several effects, then, when we find a person showing one of the effects, we can watch for the development of the others. For instance, how valuable it would be if we could discover some multiple effect, evident early in life, of the presence in an individual of a tendency toward Huntington's chorea. This is a disease that produces uncontrollable muscular movements and mental degeneration. The disease only appears in middle life, often after the individual has already produced children. The character is dominant in heredity and each child of an affected parent therefore has one chance in two of developing the same distressing malady. Could the children who have the defective heredity be certainly identified, they could then be given proper care, the production by them of offspring could be discouraged, and their brothers and sisters who are free of the defect could be relieved of the terrible apprehension that they also may in time be victims of the disease.

Another biological mechanism through which characters are associated in heredity is linkage. Genes that are located on the same chromosome tend to be inherited together, though there is a certain measurable chance of crossing-over, which results in a recombination of characters. In man there are only twenty-four pairs of chromosomes, one pair of which are the X and Y chromosomes that determine sex. There are therefore twenty-four possible linkage groups. Linkages between sex and several other kinds of characters, such as red-green color blindness and hemophilia, have already been described. Little progress, however, has so far been made in the recognition of linkages in human heredity between factors carried by the autosomes, though many such linkages have been identified in other animals and in plants. Linkages between the genes that control human characters must of necessity be very numerous. Their discovery would be of enormous practical value as a basis for advice in human heredity.

The identification of any of the hereditary factors of man will enable more exact studies to be made in the special fields of anatomy, physiology or psychology involved. Conversely, any improvement in the diagnosis of a pathology or of a particular type of behavior gives a basis for more precise studies of heredity. Advances in any one special field of the biology of man therefore will be of aid more or less directly to all other branches of human biology.

The physical and mental characters of man are evidently produced by the extremely complex interaction of numerous hereditary and environmental factors. The identification of these factors and the unraveling of their interactions can only be accomplished through the cooperation of research workers having special training in many diverse fields of biology. No one individual can possibly have the competence or the time needed for all these studies. On the other hand, if each investigator is working wholly independently, the information secured is likely to be haphazard and the problems involved will not be attacked in the most effective manner.

The study of the biology of man will be most effective, I am convinced, when a very intensive study is made of a relatively small number of families, rather than when a larger number of families is studied less intensively. In my opinion, the very best results will be secured when precisely the same families are studied from many different morphological, physiological, psychological and environmental viewpoints.

The families selected for study should be sufficiently large in the number of members they contain to allow of statistical evaluations of the results. The individual members of the family also should reside close enough to the research center so that they may be studied in detail and, if necessary, repeatedly. Furthermore, the members of the family must be willing to cooperate to the extent of furnishing information about themselves and of submitting to the essential examinations and tests. It is our experience at the Heredity Clinic of the University of Michigan that many such families can be found and that most persons are interested in and concerned about their health, their abilities and their heredity.

The data obtained in the course of such comprehensive studies as are here advocated must be filed and preserved with scrupulous care. The importance of these records can not be overestimated. They must be preserved in some central office where they will always be available to the investigators concerned. On the other hand, much of the information obtained will be of a highly confidential nature and the records must therefore be fully protected against misuse. They should be accessible only to the qualified investigators of the cooperating group. Although graduate students and other assistants may aid in the collection of some of the data these persons should not have access to the bulk of the accumulated records.

The required observations and measurements of the several members of a family will of necessity be made by numerous different observers. These observers will include anthropologists, geneticists, physiologists, zoologists, dentists, physicians and specialists in many other diverse fields. Each of them will have a different view-point and to a considerable degree a different scientific vocabulary. Nevertheless, each of them needs to be able to understand and at least in part to interpret the work of the others. Clarity and uniformity in the keeping of the records is therefore essential. Shorthand abbreviations and unusual terms should be avoided. The records should somewhere contain a clear description of each measuring instrument used and of the units in which it is calibrated. The observer must keep in mind the fact that in time instruments, methods and terms change, and that within a few years he himself may not be able to recall the manner in which certain of his data were secured.

The several members of the families selected for study should be examined and measured for their anthropological characters, for their medical history and present condition, for their physiological processes, for their reactions and intelligence and for any other measurable characters that they exhibit. So far as possible the conditions of their environment at the various periods in their life also should be measured and evaluated. Unfortunately, no satisfactory measures have been as yet devised for most features of man's environment nor for the effects of this environment on his physical and mental characters. It is true that the effects of extreme variations in some of the factors of the physical environment and of deficiencies in certain food elements may roughly be evaluated. Some slight beginnings also have been made in the development of technics for the measurement of man's psychological and social environment. Additional and improved technics in this division of ecology are greatly needed.

Many human characters develop at particular ages. Full body size, for instance, is attained only in the second decade of life. Numerous types of inherited pathologies are not evident at birth, but first appear later in life, some of them only in middle life or in old age. The age when a certain type of inherited pathology appears may differ in different families. This may indicate either (1) that the pathology in question is due to a different gene in each family, (2) that the age of appearance is controlled by different modifying genes or gene complexes in the various families, or (3) that the time of appearance is modified by differences in family environment. In any case it will be desirable to study the several members of the families being investigated over as long a period as possible of their life span.

In old age man's physical and mental abilities tend to deteriorate, though the rate of deterioration differs in different individuals. It seems very likely that this rate of deterioration may in part be based on differences in heredity, as well as upon differences in envi-

ronment. Olson and Hughes[2] have shown that the rate and type of growth in children tend to more similarity within families than between families. This strongly suggests that hereditary factors in part control the type of growth in man. It would then be particularly valuable if the same families could be studied intensively from birth, through maturity, to old age and death. Such a study would of necessity require the cooperative aid of a succession of investigators. The agency carrying out such a long-continued study must accordingly be a permanent one.

In setting up a research program for the study of man there should be no thought of ultimately establishing rules for the conduct of the people. While the scientists who investigate particular families should supply advice to the individuals, to the physicians and to the social agencies concerned, the scientists should never have control over any individual person. Most people are fully responsible and are capable of making use of advice that is to their best interests. The existing laws are in general adequate to take care of socially irresponsible individuals.

The method of setting up a cooperative research program such as I have outlined must differ to some extent in each locality. Even in those research centers where only a few aspects of the program can be carried out much could be gained by coordination of effort. In most places where research in human biology is in progress it is being conducted in numerous different departments and institutions. The independence of the individual investigators and of the departments concerned must of course be maintained. Perhaps an advisory committee set up for the purpose might sometimes suffice to unify the investigations. Such a committee could best serve its purpose if it had control of the record-keeping unit and if it had some funds available to use for filling the gaps that are certain to be present in the research program. Such an advisory committee, however, may have difficulty in maintaining the desired breadth and continuity of research.

The very best organization for carrying out a broad research program in human biology would, in my opinion, be a special unit connected with a large university where researches in many branches of human biology already are in progress. The special unit should be set up particularly to keep long-time records and to cooperate with the departments already carrying on investigations in this field. The special unit further should have funds sufficient to ensure the permanent continuity of the studies. These funds should be adequate (1) to provide a staff for the keeping of the records, (2) to give a reasonable amount of financial aid to cooperating investigators in the several established departments, and (3) to initiate and to conduct necessary studies in fields not covered by any existing department in the locality. I suggest further that the operation of this central unit should be the responsibility of a full-time director or chairman, but that the policies of the unit should be determined by an advisory or executive committee made up of a representative from each cooperating department.

I do not attempt to conceal the fact that for the most satisfactory results a research unit of the type proposed will require a considerable income from some certain and permanent source. While worthwhile information can be secured by the operation of a small unit, much more can be accomplished by the employment of a number of full-time investigators together with their necessary assistants.

A very large proportion of the current research on man now in progress in the United States is being conducted at colleges and universities, mostly by men who have numerous other responsibilities. It is extremely unlikely that any college or university will have the money in hand to set up a cooperative research unit with the breadth needed. It also is unlikely that endowments in the amounts required can be secured from wealthy people, although research grants and endowments are always of great aid in exploring new fields such as this.

The biology of man is of practical concern to every person in the nation. The provision of funds to conduct the needed investigations in this field is therefore the direct responsibility of the state and federal governments. Notable success has been attained in the scientific study of agricultural problems by the federal Department of Agriculture and the several state agricultural experiment stations. The biology of man is certainly of no less importance than the biology of dairy cows and other domestic animals.

Every state should in my opinion maintain and generously support a permanent center for research on man. Such a state research center might perhaps be called a Family Research Institute. Substations could be maintained in other parts of the state. A federal bureau or department might serve in an advisory capacity to the several state institutes and thereby tend to unify their activities, but it should not have control of their research. The state research institutes should investigate the hereditary and environmental factors causing physical and mental illness, juvenile delinquency, social incompetence and other types of human maladjustments. Due attention should also be directed toward a determination of the factors that produce improved physical health, superior men-

[2] Willard C. Olson and Byron O. Hughes, "The Child as a Whole." Ann Arbor, Mich.: Elementary School, University of Michigan. 8 pp., illus. 1939.

tal ability and outstanding social cooperation. The need for research on the biology of man is obvious; methods for conducting the investigations are fairly well worked out; and there is lacking only the leadership to develop an adequate research program and the funds to carry it out.

GEOSYNCLINES IN CONTINENTAL DEVELOPMENT[1]

By Professor MARSHALL KAY

COLUMBIA UNIVERSITY

GEOSYNCLINES, from the derivation of the word, are great depressions in the crust of the earth. The term has been applied both to large surface depressions and to thick sediments that have filled such sinking areas. The latter concern the stratigrapher. Study of the geosynclines in the interior of North America reveals several classes that differ in original form, in the derivation of their rocks and in their structural and volcanic histories.

In the early Paleozoic, a half-billion years ago, the central part of the continent, the craton, was depressed less than belts on each side, the miogeosynclines. The Cambrian system, first of the Paleozoic, is the earliest that is sufficiently known to permit reconstruction of the whole of the continent. Lower Cambrian is absent in the continental interior, but thick in the bordering belts, beyond a line from west of the Mackenzie through western Alberta, Wyoming and Arizona, and one from Labrador and the St. Lawrence through eastern New York and the Appalachians to Alabama; younger Cambrian is very thin on the craton, thickening beyond its margin. The craton was essentially a platform separated by flexures from the deeper-sinking miogeosynclines.

The more peripheral areas are so little known that there have been several conceptions of their character. Dana's hypothesis of Archean protaxes, popular last century, considered present crystalline ranges to have persisted from early times. The widely accepted theory of borderlands, developed principally by Schuchert, placed long-lived "Cascadia" and "Appalachia" on opposite sides of the continent; these were described as great lands of crystalline, principally granitic rocks, extending from well within the present coasts to beyond the oceanic shores, and persisting from the beginning of the Paleozoic to or beyond the close. The theory of marginal volcanic troughs considers regions beyond the miogeosynclines to have had deep sinking belts of sediments and marine volcanic rocks—eugeosynclines, with smaller areas in linear islands.

The theory of marginal volcanic troughs is supported by direct evidence and induction. The known sections of Cambrian and succeeding Ordovician are of miles of slates, cherts and volcanic rocks, with interbedded coarser detritus such as might have come from nearby islands. In the West, where early Paleozoic is rarely exposed, the persistence of thick marine volcanics in Paleozoic and earlier Mesozoic rocks throughout the belt suggests that the unknown early Paleozoic is similar. Thus the continent is conceived as having the interior craton separated by flexures from the deeper sinking miogeosynclines, with more peripheral belts of eugeosynclines and linear islands.

The edge of the craton did not persist as a simple flexure, as is shown in comparing successive stages of the Middle Ordovician, second Paleozoic system, along the eastern margin and in contrasting them with the mid-Paleozoic Lower Devonian. The Adirondack line can be drawn from Quebec city through the Adirondack Mountains and southern Pennsylvania to western Virginia. Successive limestone units thicken eastward from the line, then thicken westward, subsequently thin toward the line from each side and finally the limestone on the west changes to thickening shale on the east. At any time conditions were similar along one side of the line, and in contrast to those on the other. As a result of the movements, the sediments are thinner along the line than on either side. If one draws the same line on a map showing thicknesses of the Lower Devonian limestones there is little correlation, for the maxima of that series lie near the line in the Virginias and pass considerably to the east in New York.

The Upper Ordovician illustrates a third type of geosyncline, the deltageosyncline, in which thick detrital sediments within the craton were derived from uplift beyond the margin. The deltageosynclinal deposits formed in a semilenticular depression centered in Pennsylvania; they coarsen toward highlands made of rocks of the earlier geosynclinal belts to the east. Stratigraphy is similar in sections radiating from the source. Silurian sediments have similar form, but whereas the Upper Ordovician are pre-orogenic, coarser lithologies gradationally overlapping the finer away from the source, the post-orogenic Silurian has the finer gradationally overlapping the coarser toward the source. The Middle and Upper Devonian of New York is a classic section of part of a pre-orogenic deltasyncline; stratigraphic relations were misunder-

[1] Summary of an illustrated lecture presented to many of the affiliated societies of the American Association of Petroleum Geologists during March, 1944, sponsored by the Distinguished Lectures Committee of the Association.

stood until it was recognized that most of the fossils are not limited so much by age as by association with lithologies that intersect chronologic planes. The deltageosyncline is a geometric form; lines of equal thickness—isopachs, reflecting depression, do not conform necessarily to the lines of similar lithology—isoliths, influenced by the many factors affecting the surface of deposition.

The autogeosyncline is illustrated by the middle and late Paleozoic of southern Michigan. There is strong correlation between the basin structure, shown by contours of depression on a single stratigraphic plane, and the isopachs of Silurian and younger Paleozoic sediments. Successive rock units are thickest in the center of the state because that area was sinking most rapidly, the structure developing as the deposits were laid. The Illinois Basin developed similarly during the late Paleozoic. The autogeosyncline in Michigan and the deltageosynclines in Pennsylvania are separated by a less depressed belt that is the northern end of the Cincinnati arch. Autogeosynclines form within the craton without a complementary highland; the causes of their advents and passings are obscure, but they have definite durations. The present structures of some basins reflect their autogeosynclinal origin; other autogeosynclines have been folded and faulted so as to obscure the earlier behavior, or are concealed by sediments of different structural pattern.

The early geosynclines have striking correlation or coincidence with some major structures of the continent. The western belts retained much of their early character until the middle Mesozoic. There are very few west-derived sediments in the miogeosynclinal belt, and they can have come from uplifted eugeosynclinal rocks. In the Nevadian revolution of the mid-Mesozoic late Jurassic, the belt that included eugeosynclines was thrust on the miogeosynclinal belt in some areas, such as central to southwestern Nevada, and was invaded by batholiths. The resultant highlands spread detritus eastward to form the great deltageosynclinal belt of the Cretaceous on the western craton. In the Laramian[2] revolution at the close of the Mesozoic, the miogeosynclinal belt was thrust on the craton along much of its length, and invaded locally by batholiths; folds and minor thrusts formed in the deltageosynclinal belt on the craton. Subsequently, block-faulting in the Cenozoic era behind the thrusts produced the present Basin Range structure.

In the East the eugeosynclinal belt was thrust on the relatively narrow miogeosynclinal belt in the Taconian revolution at the close of the Ordovician. Deltageosynclines extended on the craton before and after the orogeny. Deposition in the eugeosynclinal belt terminated with folding and intrusion of batholiths in the Shickshockian disturbance of the later Devonian. In the southern Appalachians, the Appalachian revolution at the close of the Paleozoic thrust rocks of the Ordovician miogeosynclinal belt on the craton. Subsequently, normal faults developed in the lee of the thrusts, producing the rift-bounded geosynclines (taphrogeosynclines) of the early Mesozoic Triassic of the Atlantic Coast. Thus the structural sequence in the East closely resembles but antedates that in the West. The times of some of the events in each region are not as precisely known as the statements suggest. Moreover, this is but a description of the development of two orogenic belts; one must not assume that all had the same history.

The relationship of the Appalachian Structural Front, the northwestern major fold of the mountain system, to early geosynclines, emphasizes their plurality. The Front lies within the late Paleozoic Lower Pennsylvanian miogeosyncline from Alabama to central Virginia, where the folds trend northward in an arc into central Pennsylvania, leaving the miogeosyncline to enter an area having thick medial Paleozoic deltageosynclines. The folds tend to coincide with the area of greatest thickness of sediment, but the latter is composed of geosynclines of different types and ages. The cratonal flexure of the Lower Pennsylvanian miogeosyncline lies west of the Adirondack line, defining the Ordovician miogeosyncline, crosses it about Maryland, and is to the east in the north. Thus there is not an Appalachian geosyncline, but there are geosynclines of several sorts and of differing ages in the Appalachian region.

This has been an endeavor to emphasize distinctions among North American geosynclines, and express them in classification. Not all geosynclines are as typical, for some have been formed under plural influences, others are of sorts that have not been considered. The discussion may give a better understanding of the continental plan—if it encourages closer analysis of the deposits that confront the geologist, it will serve a good purpose.

[2] Nomenclature is simplified by considering the Laramides to be the structures of the Laramian revolution, the Nevadides, those of the Nevadian, etc.

OBITUARY

JESSE G. M. BULLOWA

IN the death of Dr. Jesse G. M. Bullowa, since 1928 clinical professor of medicine at New York University College of Medicine, science lost a keen and competent research worker, medicine an experienced practitioner and teacher and numerous patients a skilful

and versatile physician. As a colleague of long standing remarked, it will take many men to pick up the threads of his diverse activities.

Dr. Bullowa was born in New York City on October 19, 1879, and following his graduation from the College of the City of New York (1899) studied medicine at Columbia University, where he won a graduation prize (1903). He served as consulting physician at several hospitals and as visiting physician at a number of others, including Riverside Hospital, Willard Parker Hospital, the Municipal Sanitarium at Otisville, N. Y., and Harlem Hospital, where he was in charge of the pneumonia service. In collaboration with the late Dr. William H. Park and others, he developed efficient methods for the treatment of lobar pneumonia with refined specific antibacterial sera, quite a task when one remembers that apart from other kinds of etiological organisms, there are about fifty recognized types of pneumococci. He died on November 9, 1943.

He also did pioneer work in the development and use of oxygen tents in the treatment of pneumonia, and enlisted the aid of Mr. Lucius Littauer, serving as trustee of the Littauer Foundation, endowed to finance medical research. In 1936, Dr. Bullowa discussed his pneumonia researches before the Second International Microbiological Congress in London.

With the advent of the sulfa drugs, he coordinated their use, in pneumonia, with that of specific sera, and had started work with penicillin as a means of fighting the resistant Friedlaender bacillus.

In 1919 he published a translation of Bechhold's "Colloids in Biology and Medicine." In 1937, the Oxford University Press published his book, "The Management of the Pneumonias"; and in 1939 there appeared his book, "The Specific Therapy of the Pneumonias." Apart from these, he published about 160 papers on a wide variety of scientific and medical subjects, including the influence of colloidal protection on milk, Roentgen-ray studies of bronchial function and practical applications of basal metabolism. He was elected to membership in the honorary societies, Alpha Omega Phi and Phi Beta Kappa.

Dr. Bullowa's selfless devotion to his patients exemplified the highest ideals of the medical profession. It is men of his mold that bring increased honor and respect to the professions they practice. He was a well-grounded and successful diagnostician, although he once jocularly remarked that, because of inherent difficulties and uncertainties, diagnosis is the art of shrewd guessing, the ability to discern the basic cause underlying the available evidence. Apart from his personal practice and research, he taught others his skill and his ideals.

JEROME ALEXANDER

RECENT DEATHS

DR. WILLIAM D. HENDERSON, physicist, director of the extension division of the University of Michigan, died on May 26 at the age of seventy-seven years.

DR. WILLIAM MASON GROSVENOR, consulting engineer of New York City, president of the W. M. Grosvenor Laboratories, Inc., died on May 30 at the age of seventy years.

DR. J. K. ROBERTS, physicist, fellow of Christ's College, Cambridge, died on April 25 at the age of forty-seven years.

A CORRESPONDENT writes: "The Rev. G. Birkmann, a retired Lutheran minister, died on May 17 at Giddings, Texas, in his ninetieth year. Any one doing research work with insects, birds and snails or other small organisms from the Gulf Coast of the United States is familiar with the name G. Birkmann, Collector, after the name of original descriptions written by the early systematists who worked in the southern United States. This information is given for the benefit of those who desire to have a complete record of those men who made possible the wonderful collections from southeastern Texas."

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH AND DEVELOPMENT IN GREAT BRITAIN[1]

A STATEMENT of the existing Government organization has now been issued as a White Paper under the title "Scientific Research and Development" to provide a factual background for the discussion of the part which the government can play in this field after the war. After describing briefly the constitution and functions of the Development Commission and of the three Committees of the Privy Council for Scientific and Industrial Research, for Medical Research and for Agricultural Research, and the organizations working under them, the statement outlines the existing organization in each of those government departments which is faced with special scientific problems peculiar to its own field of activities and administers research and development organizations of its own or has scientific advisers on its staff.

A further section of the White Paper describes the provision made by the government for financial assistance to the universities for fundamental research, and the final section, on coordination and control organization, deals with the Scientific Advisory Committee of

[1] From *Nature*.

the War Cabinet and with the responsibilities of the Lord President of the council in relation to scientific research. Although the statement includes no account of the special wartime activities of the research councils or of the research and development organizations of the Service and Supply Departments or of the many establishments working under their direction, it provides a very convenient picture of the structure of the Government organization for research in handy reference form.

BOOKS IN TRANSLATION FOR AND FROM LATIN AMERICA

IMPORTANT books of this country, particularly in the fields of science, medicine and technology, will be made more readily available in Spanish and Portuguese translations for peoples of the other American republics as the result of a project to be conducted by Science Service, the non-profit scientific institution, as a part of the broad program of the Department of State for intellectual cooperation in the western hemisphere.

Spanish and Portuguese translations of American books, issued by publishers in the other American republics as well as by U. S. publishers, will receive financial aid under this project. Books originally published in Spanish and Portuguese will be made available in English in the United States under provisions for similar aid to U. S. publishers.

A grant-in-aid by the Department of State provides Science Service with funds to help to defray the costs of translations, to obtain and distribute copies of the translated books to libraries, institutions and other organizations, and to cooperate otherwise in making the literature of any one American republic available to other peoples on the two continents.

The purpose of this two-way translation program is "to overcome the barriers raised by difference of language by making available to the peoples of the other American republics the writings which represent the thought and the cultural and intellectual life of the United States, and making available to the people of the United States the writings which represent the thought and cultural and intellectual life of the peoples of the other American republics."

The present program supplements previous support given through other agencies to translations which were largely in the fields of literature, history, the humanities and the social sciences. The present program will include books in all fields, except elementary and secondary school text-books, although the accent will be upon scientific books.

Suggestions as to translations needed are being received from officials, scientists, educators, publishers and others in this country and the other American republics.

Trustees of Science Service are nominated by the National Academy of Sciences, the National Research Council and the American Association for the Advancement of Science. Its offices are at 1719 N St., N.W., Washington 6, D. C.

THE INSTRUMENT SOCIETY OF WASHINGTON

AT a meeting on May 24 more than two hundred scientists and engineers of Washington, D. C., formally organized the Instrument Society of Washington to ". . . increase the knowledge of its members in matters pertaining to the theory, design, development, manufacture and application of instruments and control devices in the fields of engineering and the sciences, and to . . . advance the art and science of measurement and control."

A constitution was adopted and the following officers were elected:

President: R. C. Darnell, War Department.
Vice-presidents: D. F. Windenburg, David W. Taylor Model Basin, and Colonel W. R. Blair, USA (Ret.).
Corresponding Secretary: W. A. Wildhack, National Bureau of Standards.
Recording Secretary: R. G. Quick, Weather Bureau.
Treasurer: Raymond Margary, University of Maryland.

An illustrated lecture on "Recording Instruments" was given by E. G. Howe, of the General Electric Company. The next meeting will be held on June 14, in the auditorium of the Interior Department.

This organization brings to fifteen the number of local instrument societies spontaneously organized throughout the country in the last few years. No formal action has yet been taken toward affiliation of the various groups, but it is expected that this will develop in the future.

THE INDUSTRIAL RESEARCH INSTITUTE

THE sixth annual meeting of the Industrial Research Institute, an affiliate of the National Research Council, was held in Pittsburgh on May 19 and 20. Eighty-five industrial research executives and their guests attended.

Dr. Harold K. Work, manager of research and development of the Jones and Laughlin Steel Corporation, Pittsburgh, was elected chairman for the ensuing year, and John M. McIlvain, administrative supervisor of the Research and Development Department of the Atlantic Refining Company, Philadelphia, was elected vice-chairman. Dr. Charles S. Venable, director of chemical research of the American Viscose Corporation, Marcus Hook, Pa., and Harry M. Williams, vice-president of the National Cash Register Company,

Dayton, Ohio, were elected members of the executive committee.

Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, was guest speaker at the dinner on Friday evening. He discussed the future of industrial research. Earlier in the day Maurice Holland, New York, founder of the institute, spoke on the place, influence and obligations of the institute in the national research structure.

Salary and patent problems were considered at length during the meeting. On Friday morning Mr. McIlvain discussed existing research salary conditions in industry and pointed out that these are one of the more serious causes of difficulty in retaining research personnel. In the afternoon the various methods of patent procedure used in the research organizations of member companies were discussed in detail at round table conferences. The session was conducted by Dr. R. C. Benner, research consultant of the Carborundum Company, Niagara Falls, N. Y.

Cooperative research during the war in the aircraft industry was the subject of a paper by Dr. Maurice Nelles, chief of the Industrial Processes Branch of the Office of Production Research and Development of the War Production Board, and staff assistant in research of the Lockheed Aircraft Corporation, Burbank, Calif.

The part which the manufacture of rockets, jet propulsion planes and gas turbines—wartime developments—will have in postwar industrial expansion was the subject of an address by G. Edward Pendray, assistant to the president of the Westinghouse Electric and Manufacturing Company, Pittsburgh. He discussed the technical aspects and historical development of these devices and the possibilities of their future development.

The autumn meeting of the institute will be held late in September.

THE WARRINGTON YORKE MEMORIAL FUND

COLONEL RICHARD P. STRONG, M.C., director of tropical medicine, Army Medical School, has sent to SCIENCE an appeal that he has received from Dr. R. M. Gordon, professor of entomology at the Liverpool School of Tropical Medicine, for subscriptions for the establishment of a Warrington Yorke Memorial Fund. It reads:

The late Professor Warrington Yorke was a product of the Liverpool School of Tropical Medicine and one of its most distinguished members. In addition to his jealous maintenance of the high standards set by earlier workers at the school, he earned for himself an international reputation in the world of medical science, and his outstanding original work on trypanosomiasis, blackwater fever, the nematode parasites and many other parasitic and tropical diseases has permanently enriched our knowledge of these subjects.

In the latter part of his career, so untimely cut short, Yorke's exceptional energy and ability were increasingly devoted to the elucidation of the mode of action and the therapeutic value of chemical compounds, especially in parasitic diseases. As a direct result of his pioneer work, new and more potent weapons were forged to combat a number of diseases, in particular leishmaniasis and trypanosomiasis. That these discoveries were of far more than academic interest has been proved by their increasingly wide employment; indeed, it may be said that Yorke's introduction of drugs of the diamidine series is rendering possible the mastery of kala-azar in those parts of the world where the disease is peculiarly resistant to the antimonial compounds.

At the time of his death further studies in chemotherapy had been initiated by him, and it was his avowed object to promote chemotherapeutic research in Great Britain to the front rank and firmly to establish Liverpool as one of its leading centers. To that end, he laid a sound and solid foundation on which to build, but, though he lived long enough to see the realization of his ambition begun, he did not see it consolidated.

The Council of the Liverpool School of Tropical Medicine feels that a fitting memorial to this remarkable man would be to place on a firm financial basis the recently created Chemotherapeutic Research Department, where the work which he inaugurated will be continued in association with his name. To this end a Warrington Yorke Memorial Fund has been opened, and the council believes that Yorke's many colleagues, friends, past students and others who have benefited by the great advances which he helped to make in tropical medicine and hygiene during his forty years of service will wish to be associated with this memorial; from such the council would welcome subscriptions, however small, which should be addressed to: The Honorary Treasurer, Liverpool School of Tropical Medicine, The Chamber of Commerce, 1, Old Hall Street, Liverpool.

SCIENTIFIC NOTES AND NEWS

THE Elbert H. Gary, Memorial Medal of the American Iron and Steel Institute was presented at a meeting of the institute on May 25 to Quincy Bent, vice-president of the Bethlehem Steel Company, in

recognition of his "outstanding leadership in steel production and contribution to the development of alloy steels."

DR. EDWIN H. ARMSTRONG, professor of electrical engineering at Columbia University and inventor of frequency modulation in radio reception, has been awarded by the War Department the certificate of appreciation of the first chief signal officer in recognition of "a notable contribution to the war effort when he waived all royalties on the use of seventeen of his patents covering frequency modulation radio apparatus purchased by the War Department for military purposes."

DR. J. C. GEIGER, director of public health of the City and County of San Francisco, has been granted by the Government of Ecuador the decoration "Al Merito" with the following citation: "For distinguished service, for noteworthy and indomitable leadership in the advancement of public health in the Americas."

A COPERNICAN Award has been presented by the Kosciuszko Foundation, New York City, to Dr. Frederick C. Leonard, associate professor of astronomy at the Lick Observatory of the University of California, in recognition of his "effective cooperation with the foundation in the observance of the Copernican Quadricentennial."

DR. HARRY BATEMAN, professor of mathematical physics and aeronautics at the California Institute of Technology, and Dr. W. M. Whyburn, professor of mathematics and chairman of the department at the University of California at Los Angeles, have been elected corresponding members of the Academia Nacional de Ciencias Exactas, Fisicas y Naturales de Lima.

AT the invitation of the Cuban Government and Dr. Alberto Recio, the Minister of Health, Brigadier General James Stevens Simmons, chief of the Preventive Medicine Service, Office of the Surgeon General, U. S. Army, visited Havana on May 17, and took part in the dedication of the new National Institute of Health. During the ceremonies President Batista decorated General Simmons with the Medal of the Carlos J. Finlay National Order of Merit in the grade of *Gran Official*. The President also sent by General Simmons to Major General Norman T. Kirk, Surgeon General of the Army, a certificate conferring the Carlos J. Finlay Order of Merit in the grade of *Gran Cruz* on the former American Yellow Fever Commission for its fundamental experimental work in Cuba on the etiology and transmission of yellow fever under the leadership of Major Walter Reed. The certificate will be preserved in the Army Medical Library in Washington.

THE honorary degree of doctor of science has been conferred by the Ohio State University on Dr. Thomas Midgley, Jr., president of the Ethyl Corporation and president of the American Chemical Society, in recognition of his achievements in fuel research.

THE honorary degree of doctor of science was conferred on May 29 by Virginia State College on Lloyd A. Hall, chief chemist for the Griffith Laboratories, Chicago, in recognition of "his many years of outstanding work in, and his contribution to, food chemistry."

DR. JOHN ALEXANDER, professor of surgery of the Medical School of the University of Michigan, delivered on May 18 the Henry Russel Lecture for 1944 given by the member of the faculty who had attained "the highest distinction in the field of scholarship." His lecture was entitled "Developments in Thoracic Surgery." Dr. Frederick K. Sparrow, Jr., assistant professor of botany, received the Russel Award as the junior member of the faculty whose achievements in scholarly activities and whose promise for the future seemed most to merit the appointment.

THE Clubes Cientificos de Mexico held a special session on May 3 in the Theater of the Palacio de Bellas Artes upon the occasion of the visit to Mexico City of Watson Davis, director of Science Service and of the Science Clubs of America, with which the Mexican science clubs are affiliated. The principal address was by Dr. Manuel Sandoval Vallarta, director of the National Polytechnic Institute of Mexico, while other speakers were Ing. D. Salvador Magana, organizer of the science clubs at the Polytechnic Institute; Gustavo R. Cota, and Professor Agustin Aragon Leiva, head of the Science Service Bureau in Mexico.

AN informal reception was given on May 28 for four members of the faculty who will retire on June 30 from the College of Science, Literature and the Arts of the University of Minnesota. They were Dr. W. H. Emmons, head of the department of geology and director of the Minnesota Geological Survey; Dr. L. Miller, professor of physics; Dr. C. O. Rosendahl, head of the department of botany, and Dr. C. R. Stauffer, professor of paleontology. Approximately two hundred associates, former students and friends were in attendance.

DR. FELIX BERNSTEIN, professor of biometry at New York University, has been appointed professor emeritus.

DR. FREDERIC PALMER, since 1916 professor of physics at Haverford College, will retire from active teaching at the close of the academic year.

THE retirement is announced of Dr. Charles C.

Johnson, professor of pharmacology and physiology at the School of Medicine of the University of Utah.

AT Columbia University, Dr. A. Irving Hallowell, chairman of the department of anthropology of the University of Pennsylvania, has been appointed visiting professor of anthropology; Dr. Henry E. Garrett has been appointed head of the department of psychology, and Dr. Thomas T. Read, head of the department of mining and metallurgy.

DR. RUSSELL SPURGEON POOR, professor of geology and head of the department at Birmingham-Southern College, has been appointed dean of graduate studies and director of the Research Council of the Alabama Polytechnic Institute.

DR. H. HOUSTON MERRITT, associate professor of neurology at the Harvard Medical School and visiting neurologist at the Boston City Hospital, has been appointed professor of clinical neurology in the College of Physicians and Surgeons, Columbia University, and chief of the Division of Neuropsychiatry of Montefiore Hospital. He will succeed Dr. S. Philip Goodhart, who is retiring after serving for thirty-one years. Dr. Merritt will be in charge of the investigative and clinical work of the division of neuropsychiatry of the hospital. Dr. Goodhart has been made consultant in the division of neuropsychiatry.

K. L. TURK, professor of dairy husbandry and head of the department at the University of Maryland, has resigned to become professor of animal husbandry in Cornell University.

DR. F. W. FROMM has resigned as professor of chemistry at the Polytechnic Institute of Puerto Rico at San Germán, in order to work in the same capacity at the College of the Sacred Heart, at Santurce, Puerto Rico.

IN a recent issue of SCIENCE, Dr. R. A. Baker, professor of chemistry in charge of the department of the commerce center of the College of the City of New York, was referred to as head of the department of chemistry. This is incorrect. Dr. William L. Prager is chairman of the department.

SIR JOHN FRASER, Bart., regius professor of clinical surgery at the University of Edinburgh, has been appointed to succeed Sir Thomas Holland as principal of the University of Edinburgh.

DR. GEORGE C. DECKER, research and extension associate professor of entomology in the Iowa State College, has been appointed entomologist of the Illinois Experiment Station and of the Illinois State Natural History Survey.

DR. ERNST MAYR, of the department of birds of the American Museum of Natural History, has been promoted by the trustees from associate curator to curator of the Whitney-Rothschild Collections, in recognition of his "ornithological scholarship and his constructive service to the department of birds."

MAJOR JOSEPH B. FICKLEN, III, engineer of the U. S. Public Health Service, has joined the Industrial Hygiene Division of the Department of County Health of Los Angeles.

DR. HARVEY A. ZINSZER, since 1929 head of the department of physics and astronomy at the Kansas State College at Fort Hays, has been granted indefinite leave of absence to accept a war defense position in the Cruft Laboratory of Harvard University.

DR. A. G. PLAKIDAS, plant pathologist for the Louisiana Agricultural Experiment Station at Baton Rouge, has been granted leave of absence to serve with the United Nations Relief and Rehabilitation Administration as district agricultural officer with the Balkan Mission overseas.

THE first Richard H. Jaffé Lecture of the Institute of Medicine of Chicago, established in memory of Dr. Jaffé, pathologist of Cook County Hospital, who died in 1937, will be delivered on June 23 at the Palmer House by Dr. William F. Petersen, chairman of the Board of Governors of the institute. He will speak on "Organic Variability and Heart Disease."

SIR JACK DRUMMOND, F.R.S., gave on June 2 the Friday evening discourse at the Royal Institution of Great Britain, London. He spoke on the Hot Springs Conference and its bearing on nutrition in Great Britain.

THE American Society of Zoologists, in conjunction with Section F of the American Association for the Advancement of Science and in association with other biological societies, will hold its annual meeting for 1944 in Cleveland, Ohio, on Tuesday, Wednesday and Thursday, September 12, 13 and 14. The deadline for the receipt of titles and abstracts by the secretary is July 15. The preliminary announcement and call for papers will be issued by the secretary, Dr. L. V. Domm, the University of Chicago, in the near future.

THE fifty-eighth annual convention of the Association of Land-Grant Colleges and Universities will be held in Chicago from October 24 to 26. Preconvention sessions are planned from October 21 to 23.

A MEETING of the Aviation Division of the American Society of Mechanical Engineers was held from June 5 to 8 at the University of California at Los Angeles, where it is planned to establish a College of Aeronautical Engineering.

A SPECIAL meeting of the American Shore and Beach Preservation Association, under the presidency

of J. Spencer Smith, president of the New Jersey Board of Commerce and Navigation, met in Chicago on May 31 and June 1. This was the first national conference on coastal erosion problems and allied subjects held since the association suspended its regular sessions for the duration of the war. The Beach Erosion Board of the Corps of Engineers of the United States Army held a meeting concurrently with the conference of the association.

BY the will of Dr. Oscar M. Stewart, emeritus professor of physics at the University of Missouri, his estate, the estimated value of which is in the neighborhood of $100,000, is bequeathed to the department of physics, "the net income to be used for some educational or scientific purpose connected with the department."

THE *Experiment Station Record* reports that the Inter-American Institute of Agricultural Sciences has now acquired a permanent status through the ratification of the convention for its establishment by eight republics—the United States, Costa Rica, Cuba, Ecuador, Nicaragua, Panama, Honduras and the Dominican Republic. A permanent faculty is being selected, and construction is proceeding in the building program at Turrialba, Costa Rica. A substation for the development of high-yielding and disease-resisting rubber trees has also been opened in Panama.

THE British Mycological Society, according to *Nature,* is making a collection of surplus reprints and pamphlets on mycology and plant diseases for distribution after the war to libraries and centers of research at home and abroad which have suffered loss or damage. Authors are invited to send reprints of their own published work and any other reprints or pamphlets which they can spare to G. C. Ainsworth, secretary of the British Mycological Society, Imperial Mycological Institute, Ferry Lane, Kew, Surrey.

IT is reported in *Nature* that the Royal Society of Edinburgh has been made the residuary legatee of the estate of Robert Cormack, of Edinburgh, who died on August 13, 1942. The society is directed to administer this bequest for the purpose of promoting astronomical knowledge and research in Scotland, so far as practicable, on the lines of a memorandum prepared in 1931 by the late Professor R. A. Sampson, Astronomer Royal for Scotland. The council, on behalf of the Royal Society of Edinburgh, has accepted the bequest, which represents an amount somewhat over £30,000; and, after careful consideration, has approved a general scheme for the administration of the trust, which will include: (*a*) research fellowships to be awarded on suitable conditions to students engaged on research in Scottish observatories and to students or graduates of Scottish universities desirous of engaging in research in foreign or Dominion observatories; (*b*) the publication of the results of such research; (*c*) lectures to be delivered in suitable centers by eminent foreign or Dominion astronomers; (*d*) grants in aid of the purchase of special equipment for use in Scottish universities or observatories in research work; (*e*) lectures and demonstrations of a more popular character under the auspices of the Scottish educational institutions. A large part of this scheme will not be developed during the war.

DISCUSSION

NOTE ON STABILITY OF INCIDENCE OF THE "COMMON COLD"

IN one of the best statistical analyses upon data assembled under good control which has been offered for discussing stability of resistance to the common cold, Gafafer and Doull[1] found that the hypothesis that the colds of their samples were distributed by chance was not improbable. Their fundamental technique was that of showing that in each year with each sample the distribution of the number of colds was according to the point-binomial or law of small numbers. They found that the numbers of colds suffered by the same individuals in different years were correlated to a small extent in a variety of groups of persons. If we should calculate the correlation coefficients for the three pairs of years for the 111 persons under continuous observation for the three years (Table 5, p. 720) we should find $r = .44, .38, .35$, each of which is alone significant. This, as they must have known, was in itself some evidence that the distribution of the colds was not quite by chance, even though the distributions were well fitted by the law of small numbers.

There are indeed some limitations to the use of the law of small numbers as evidence of chance behavior; of these one is the difficulty of determining whether the law is satisfactorily fitted. Consider, for example, the distribution of colds of each of the 111 persons for the whole three years, the numbers varying from 0 to 21. The mean of the distribution is 8.315 and the variance is 13.00, which indicates a hypernormal distribution with too much dispersion about the mean as would be the case if some were resistant and others susceptible to colds. Now $\sigma = 3.61$ as computed from the distribution and $\sigma = 2.88$ as estimated from the

[1] W. M. Gafafer and J. A. Doull, *Amer. Jour. Hygiene,* 18: 712–726, 1933, and SCIENCE, 78: 314–315, 1933.

square root of the mean on the assumption of the law of small numbers are significantly different[2] (diff. = $.73 \pm .19$) if we make a rough estimate throwing all the variability on to the observed value of σ. On the other hand, for the three distributions for each of the three years, we have for the means and variances $m = 3.00$, $\sigma^2 = 2.68$; $m = 2.83$, $\sigma^2 = 2.70$; $m = 2.49$, $\sigma^2 = 1.93$, which indicates that in each year the distribution is subnormal. Even if these three distributions be thrown together despite the inter-year differences of m, the resulting distribution is subnormal, with $m = 2.77$, $\sigma^2 = 2.48$. Thus there is evidence that the variation is less than that due to chance, as well as evidence that the variation is greater than that due to chance, entirely apart from the evidence of the correlations cited above.

At the time Gafafer and Doull were writing (1933) the analysis of variance had hardly got into the literature.[3] It would appear that this method of analysis might be one very appropriate to the discussion of their exceptionally good data. If we consider that the number of colds n_{ij} of the ith person in the jth year ($i = 1, 2, \ldots, 111$; $j = 1, 2, 3$) consists of one part appropriate to the individual, one appropriate to the year and a residual independent of both, Table 1 may be constructed:

TABLE 1

	Sum of squares	Degrees of freedom	Mean square
(1) Between year means ..	15.2	2	7.60
(2) Between person means .	480.7	110	4.37
(3) Residual fluctuations ..	330.8	220	1.50
Total $S(n_{ij}-n)^2$	826.7	332	...

The values of the mean squares indicate that the variation from year to year ($\sigma_y = 2.8$), poorly established because of the small number of degrees of freedom, is considerably larger than the variation ($\sigma_p = 2.1$) between persons; but as the ratio 7.60 : 4.37 of the variances is not significant, one may not claim the difference as meaningful.

Compared with the residual variance 1.50, both that between years and that between persons is significant, for the former at around the 1 per cent. level and the latter at well below that level. The evidence is therefore corroborative of that offered by the inter-year correlation coefficients to the effect that there is significant evidence that the distribution of colds was not by chance but was affected by an inter-individual variation of resistance to the common cold or by some systematic influence which simulated it, such as a higher exposure rate among some than among others of the persons under observation.

E. B. WILSON
JANE WORCESTER
HARVARD SCHOOL OF PUBLIC HEALTH

[2] Although the distribution seems to be very significantly hypernormal, the chi-square test applied to it gives a variety of results from $P = .05$ to $P = .50$, according to the manner of grouping, and fails to indicate in any clear manner that the fit is significantly bad.

[3] R. A. Fisher, "Statistical Methods for Research Workers," 1925, and subsequent editions, Chapter VII; G. W. Snedecor, "Calculation and Interpretation of Analysis of Variance and Covariance," 1934; G. U. Yule and M. G. Kendall, "An Introduction to the Theory of Statistics," 1937, pp. 444–449. Reference should also be made to two articles by J. O. Irwin, *Jour. Roy. Stat. Soc.*, London, pt. II, 1931, 284–300, *ibid.*, Supplement, 1: 1934, 236–251.

RESUSCITATION APPARATUS

THE recent controversy between the late Professor Yandell Henderson and Council on Physical Therapy of the American Medical Association contains a most unhappy and serious implication. It would appear, from the matter presented, that the recovery of the asphyxiated patient turns exclusively upon the operation of mechanical gadgets designed to meet and overcome all conditions accompanying the unconscious state. If the patient recovers, he has been saved; if he dies, he was beyond all hope of rescue.

This implication would seem to confirm the layman's everyday observation, the patient with a persistent headache, an abdominal pain or a fracture is a serious medical problem. He demands, and if it is available he receives, the best medical care obtainable. But should unconscious or respiratory failure supervene, his condition is suddenly simplified to a point where the police, the fire or the consolidated gas squad is all the assistance required. If the squad can bring or borrow an inhalator or a resuscitator, everything is perfect. Or—

If a child inhales a peanut or a pin, he is hustled off to the hospital and receives every advantage of the bronchoscopic clinic. Should he be so unfortunate as to inhale something larger, a marble or a chunk of meat, he is no longer in need of medical help. Everything will be solved if the suck and blow apparatus used last week in the stevedore down the street can be secured.

Asphyxia-conscious physicians are well aware of the phenomena which occur between the onset of unconsciousness and the death of the patient. They are prepared to control and to direct these phenomena. Treatment must necessarily vary with the stage of asphyxia treated. The depressed, the spastic and the flaccid patient each requires a different approach. It is frequently fatal to attempt to fit the desperately ill patient into treatment suited to the patient who is merely depressed. It would seem as reasonable and in many cases safer to attempt to employ a mechanical robot for a brain operation, on the basis of electrical potentials, than it is to attempt to subordinate respiratory rate and rhythm in a patient about to die.

Controversy over mechanical gadgets plays directly

into the hands of commercial interests, without contributing to the problem at issue. It is most regrettable that medical leaders and respected medical groups should be betrayed into a position where their directive influence deteriorates to the level of the pros and cons of a mechanical gadget. Yandell Henderson was perfectly correct when he said that resuscitators killed thousands of patients—not as bullets do directly, but by providing a gesture and alibi for the correct treatment required.

Instead of such unfortunate emphasis, therefore, why not put more emphasis on the problem requiring treatment? While it is granted that this would be out of place in clinical disease involving biochemical reactions, extending over a period of time, it is quite in order in conditions in which mechanical problems are involved, where a life may be saved or lost in a few minutes.

Radio, aerodynamics and many other skills are quickly picked up by lay men and women. Why not popularize the mechanics of asphyxiation? Not as heretofore by a frozen drawing of the respiration, but as the very much alive mechanism which depends upon reflexes and normal muscles for protection and which presents, progressively, a totally different problem, when asphyxia has put these protective factors out of commission and blocked the airway with blood, vomitus or other foreign matter. Any one with ordinary mechanical sense could promptly improvise relief for these situations once they are understood. He would soon know as well or better than a salesman whether or not a given resuscitator was of much use to him. Why not debunk the mystery of the mechanics of asphyxia?

The informed layman will have little difficulty in appreciating that an air line which is blocked can not function, that an obstruction can sometimes be bypassed more easily than it can be overcome. He will understand how gas pressure in the nose and mouth can blow vomitus or blood which may be in it into the windpipe. He can observe a change in the color of the patient as well as any one, if he is instructed to look for it.

The entire approach to the devastating problem of asphyxia should be revamped. What is treated should become the important thing. Thousands will continue to die until the patient and not the apparatus becomes the issue.

It is respectfully suggested that the Council on Physical Therapy or the Council on Medical Education issue a statement covering the presently accepted views relating to the pathological physiology of asphyxia, *i.e.*, the stages of asphyxia, the signs which accompany each of these stages, the indications for the correct treatment of each stage, the simplest means by which these indications may be met. A patient about to die is entitled to the maximum effort in rescue; after this consideration the late effects of such treatment are to be considered and measured. The indications for treatment are clearly indicated in the pathology of each stage; any experienced pneumatologist (gas therapist) is familiar with the care of the unconscious patient.

When the needs of the patient are clearly stated by a recognized authority and the simplest means of meeting these needs are described, resuscitation equipment will automatically fall into line in response to the law of supplying what the informed public demands.

PALUEL J. FLAGG, M.D.

NEW YORK, N. Y.

WITH interest I read the reply of the Council on Physical Therapy of the American Medical Association to the late Yandell Henderson's attack on the Pulmotor and its successors. It is possible that this article, as it appeared in SCIENCE, December 24, 1943, was the old warrior's last use of his mighty battle-axe—and I honor it.

A controversy between advocates of what Henderson terms "suck and blow" on one side and advocates of insufflation on the other side is only of recent date, but the actual fight against suction to the lungs has been going on for thirty years. A sharp battle line could be drawn between Roth-Draeger, the German originators of the Pulmotor, Coryllos, the lone proponent, and now the council on one side and the three opponents of negative pressure, Meltzer, Henderson and Flagg, on the other side. During this thirty-year period "suck and blow" was several times knocked out but was always revived. At present the survival of the fittest seems indefinitely dated ahead.

Considering that Yandell Henderson spent practically half of his lifetime in research on the subject of resuscitation and its kindred, and that his devotion to the study of the physiology of respiration was truly scientific, the reply of the council doesn't seem to me a scientific repartee. The council argues on the principle of "the proof of the pudding is in the eating" when asserting that, statistically, resuscitation apparatus applying positive and negative pressure has never killed a patient nor injured respiratory organs. On that basis the council is fully justified in considering the principle as workable and in accepting the apparatus in question, but as an argument against Henderson's assertions it is far from the point.

Only in one instance the council uses a basic figure. It is the reference of a safe positive pressure to the lungs of 13 mm. Hg., and this is conspicuously a factor to which Yandell Henderson paid less attention than to other factors. What he was mostly concerned with

when warning of the dangers of the "suck and blow" resuscitators was the factor of negative pressure to the lungs and the impossibility to synchronize with the patient's respiration.

The first warnings on these features appeared in the report of the Bureau of Mines in 1914.[1] It was the report of the committee on resuscitation that "killed the Pulmotor," and Henderson from then on stood up for the findings then established. It would be of interest at this time to know whether the Bureau of Mines had any reason to alter their opinion since then and whether eventually they give the principle of "suck and blow" a right to be.

One of the committee of 1914 was the late Dr. S. J. Meltzer, of the Rockefeller Institute, and it was his disbelief in the safety of negative pressure to the lungs and his belief in the necessity to synchronize which led him to develop the simple, safe and inconspicuous method of resuscitation known as the Meltzer method. It is on the principle of pharyngeal insufflation with a limited safe pressure, leaving deflation to the natural contraction of the chest wall, first published in the *Journal* of the American Medical Association, May 10, 1913, and later adopted by Henderson and Haggard, by the Society for the Prevention of Asphyxial Death, by many specialists on respiration and, with modifications, used by many institutions all over the world.

Naturally an apparatus built on the principle of insufflation only is not as impressive as an apparatus built on the principle of positive and negative pressure. It is human nature, without sufficient thought, to be impressed by the performance of a device apparently so similar to the functions of human respiration. The fact that human respiration is just the reverse, that it is done with negative pressure at inspiration and positive pressure at expiration, while the pumping apparatus applies positive pressure at inspiration and negative pressure at expiration is not considered or I will say not even recognized.

With all due respect to the council, I still believe in Yandell Henderson.

RICHARD FOREGGER

NEW YORK, N. Y.

A NEW PRESIDENT FOR THE HARVARD APPARATUS COMPANY, INC.

IN 1898, three vital changes in the teaching of physiology were proposed:[1]

(1) Since physiology consists not of words but of basic experiments, the student must every day make such experiments for himself. (2) Experiments too difficult or time-consuming shall be dealt with by a separate committee of three students, which committee shall report to the class the account given by the discoverer; and the committee shall show to their mates the original source. (3) There shall be no more lectures in the old sense. The professor and his staff shall discuss with the class the student's experiments immediately after he has made them; and they shall discuss very difficult experiments only after the students have read the discoverer's own statement of the discovery.

Such instruction, based on experimentation, requires large stores of apparatus, accurate but inexpensive.

So the Harvard Apparatus Company was launched. New instruments were invented; old instruments were redesigned for "quantity production."

Forty-five years have now passed. The company has all this time been in the hands of its founder and his admirable associates.

The founder believes it is time to have a new president.

In our search for the new president we have been fortunate indeed. We have found a man of uncommon ability—a man who has earned the profound respect of our profession and our very real affection.

Dr. A. J. Carlson will be president of the Harvard Apparatus Company, Incorporated, beginning on June 1, 1944.

W. T. PORTER

DOVER, MASS.

[1] U. S. Technical Paper No. 77.

[1] See footnote to page 2 of a paper on "The Teaching of Physiology," *Philadelphia Medical Journal*, September 1, 1900.

GENERAL BIOLOGY

THE distinction between the "biological sciences" and the "physical sciences" emphasized by Professor Shull in a recent number of SCIENCE,[1] is a very excellent one. Since it raises the biological sciences to a level where each is commensurate with the exact ones, "physics, chemistry, mathematics, meteorology, geology, astronomy, etc.," the distinction has a most attractive sound to teachers and workers in the less exact, biological subjects. Carried to its logical conclusion, colleges and universities should be reorganized, either by amalgamating the physical sciences into one department or by elevating zoology and botany, perhaps also physiology, genetics, microbiology, ecology, etc., each to full departmental importance. Psychology and anthropology, already full departments in many institutions, might be considered parts of this group.

In the first alternative, it would undoubtedly be necessary to "concoct" a "hodge-podge" course as an "extraction of all" the physical sciences, presenting it as an introduction to these subjects. Since Professor Shull deplores "general biology," so too he would unquestionably object to such a course as "gen-

[1] SCIENCE, n.s., 99: 199, 1944.

eral physical science." The second alternative has interesting possibilities. Each of the new departments would be sure to offer a "general" course, each bidding for student election on the basis of being the most outstanding for some particular reason. Students not planning to major in the sciences are usually required to take toward their "liberal" education at least one course in the physical sciences, and one laboratory course in the biological sciences. Under the revised arrangement, such a student would satisfy the spirit and letter of the requirements by taking one specialized course in each—say "general mathematics" and "general physiology." In the number of class hours available, could such a student be given the insight into the biological sciences now provided in a good general biology course? Could the "insight" be provided without adding to the total of required courses? Is the "insight" worth including in a liberal arts education? Why else does the requirement exist?

Freed of any close association through offering a course in "general biology" the preference for subject-matter shown by teachers and workers tends to draw them apart. The multiplicity of biological societies and journals is a good example of this tendency. But when a botanist, a zoologist, a physiologist, etc., must work together in presenting a "general biology" course, each acts as a check on the others. The botanist does not insert specialized information on neck canal cells, nor the zoologist the terminology of homologous segments in the crustacean appendage, nor the physiologist the logarithmic relationship between this and that, delectable as these items may be. The others object. In consequence the student is given an introduction to most of the branches of the biological sciences, with few of the technical details. Borderline subjects are mentioned in relation to the different aspects of the field. Biochemistry, biophysics, biometry, biogeography, bio-ecology, etc., form unifying bonds to connect the biological sciences with the physical sciences and with each other.

Perhaps a course in "general physical science" is an excellent suggestion. If the mathematics staff, the physics faculty, the chemistry group, etc., were to sit down together and each agree on what the other offered, each trying to get the other to orient the subject-matter into some understandable relationship, would the product perhaps give a better "insight" into the physical sciences than can be gained from one course in "general physics" or one in "general chemistry?" Perhaps such a group might be led to include not only some physical chemistry, etc., but also to show in their course how much relationship there is between the physical and the biological sciences.

As a biologist who found considerable stimulation to thought in pre-war collaboration with colleagues while presenting a share in a general biology course, and as a war research investigator needing familiarity with all the biological and physical sciences, the writer can sympathize with Professor Shull, yet at the same time feel that a closer, rather than a looser coordination between these sciences is particularly desirable in both the teaching and research fields.

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SCIENTIFIC BOOKS

CYTOCHEMISTRY

Frontiers in Cytochemistry. Vol. X, Biological Symposia. Edited by Professor NORMAN L. HOERR. 334 pp. Illustrated. Lancaster, Pa.: The Jaques Cattell Press.

THIS volume represents a series of lectures given at a symposium held at the University of Chicago in honor of Professor R. R. Bensley's seventy-fifth birthday. A paper by Dr. Bensley himself, on the chemistry of cytoplasm, aptly serves as a summary of the principal contributions of the volume.

For the most part the approach of biochemists to the problem of describing the metabolic activities of living material has involved the use of techniques which disregard the heterogeneity of the cell or of the tissue being studied. It is to be expected that the only enzyme reactions to survive this treatment would be those characterized either by an exceptional and persisting activity or by the resistance of their component parts to the deleterious influences involved in breaking up cell structure.

However, due largely to the influence of Professor Bensley, a group of investigators, for the most part men who are trained as cytologists, have begun to attack the problem of localizing within the individual cell particular parts of the enzyme reactions which we write now as descriptions of the over-all metabolic process. Perhaps many of the difficulties in our present over-all schemes will be resolved when we are able to draw a precise biochemical map of a cell.

At the present time it is possible to separate or characterize cell fractions constituting the nucleus, components of the nucleus, mitochondria, a submicroscopic lipo-protein complex, Nissl bodies in the case of nerve tissue and protein fractions which apparently constitute the structural elements of the cell. Cyto-

plasm is regarded therefore as containing a structural framework (largely of fibrous proteins) embracing a liquid menstruum containing soluble proteins, metabolites and inorganic salts, in which are embedded microscopic and submicroscopic particulates of highly complex composition. Both the chemical nature and the biochemical properties of these components vary widely.

Lazarow contributes a detailed discussion of the results of the investigation of these factors carried out in the Chicago laboratory within the past ten years. Along the same lines Claude describes the distribution of nucleoproteins among the various components of cytoplasm, and Gersh and Bodian report on a histochemical analysis of the changes occurring in motoneurons of the Rhesus monkey after root section. The methods used in separating various cellular components are treated at length in an article by Hoerr on the liver cell, while Beams describes the value and use of the ultracentrifuge in studies of this sort. Mirsky and Pollister discuss the fibrous nucleoproteins of the cell, and Schmitt, Hall and Jakus describe work in which they have examined various fibrous structures (collagen fibers, cilia, flagella, etc.) by use of the electron microscope. The soluble components of the cytoplasm are discussed in an article by Stern on such macromolecular particles in cytoplasm as ferritin, the complex containing cytochrome oxidase and the cytochromes, bacteriophage, etc. Articles by Chambers, Lowry and Scott are concerned primarily with the mineral constituents of protoplasm, Chambers describing experiments using his microdissection technique, Lowry describing investigations of the type initiated by Hastings, Eichelberger and their associates, while Scott reports studies of mineral distribution using the electron microscope. Striking differences in mineral content between intra-cellular and extra-cellular fluids have been recognized for some time. It becomes clear now that there are also intracellular localizations in mineral distribution. A review by Barron discussing various features of cellular respiration and a paper by Cowdry describing in detail the histological changes involved in the development of carcinomata in mice treated with methylcholanthrene complete the volume.

There can be no question of the importance of the objectives of the research discussed in this volume. Up to now the emphasis of workers in the field has been, as Professor Bensley rightly says, on "separating things before proceeding to their analysis." While knowledge as to the enzymic and chemical composition of these various cellular components is still slight, it is clear that biochemical schemes of intermediary metabolism must eventually be expressed in such terms and reconciled with such data.

As is the case with most books of this kind there are individual statements, ranging from matters of pure error to questions of proportion and opinion, with which one may disagree: for example, QO_2 (page 18) is not the customary symbol for respiratory quotient nor can one agree, for example, with the statement (page 56) that "oxaloacetate is used . . . as the phosphorylated compound in the formation of phosphopyruvate and synthesis of carbohydrate. It might also produce isocitrate"—when the first of these reactions is supported by no direct experimental data while the synthesis of isocitrate from oxaloacetate has been demonstrated beyond question. However, these are typical of the small flaws in what is, in general, an admirable effort.

The book has been edited by Professor Norman Hoerr and includes an appreciation of Dr. Bensley's work by E. V. Cowdry and an excellent portrait of Professor Bensley as a frontispiece. In format and typography it corresponds to the other volumes of the series.

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REPORTS

PRESENT TEACHING ACTIVITIES OF THE SCHOOL OF TROPICAL MEDICINE, IN COOPERATION WITH THE INSULAR DEPARTMENT OF HEALTH

IN 1926, at the inaugural ceremony that launched the School of Tropical Medicine as the first of its kind in the Americas, Dr. William Darrach, then dean of the College of Physicians and Surgeons of Columbia University, defined the objectives for which the new school had been founded as "the study and teaching of physical and mental ills as they occur in the tropics." These objectives were further defined in an early announcement of the school, thus: "The primary aim of the school is to give opportunity to study in a tropical environment the cause and prevention of that large group of ill-defined disorders known as tropical diseases and, at the same time, to observe the influence of tropical conditions on disease in general." Again in his inaugural address, when commenting on the advantages of Puerto Rico as the site for the School of Tropical Medicine, Dr. Darrach said, "The student will have the opportunity to see not only the dark side of conditions and their distressing effect on mankind but also the brighter side of what is being done to con-

trol them . . ." (referring to the work that was then being carried on by the Insular Department of Health).

Since its beginning, the School of Tropical Medicine strove to establish close relations with the Insular Department of Health—a strongly centralized organization that maintains active contact with every part of the island—and has cooperated in research projects and teaching activities, many times pooling mutual resources for the benefit of both. In 1940, the Insular Department of Health was able to expand its activities as a result of additional budgetary appropriations made possible by the inclusion of Puerto Rico under the provisions of Titles V and VI of the Federal Social Security Act. The need for personnel trained in public health to direct the various new functions, in which the department was to participate, was immediately apparent. It was imperative to organize a teaching program as soon as possible and the School of Tropical Medicine, with its already well-developed departments of bacteriology, chemistry and nutrition, clinical medicine, dermatology, medical zoology and pathology, and its adjoining 50-bed hospital being operated as the school's chief teaching and research clinic, was the logical place for setting up the necessary training schedules.

Therefore, with the financial assistance of the Insular Department of Health, a Department of Public Health was created in the School of Tropical Medicine. During the first year courses for health officers, public health nurses and laboratory assistants were offered as a preliminary step in developing this program of education. Two hundred individuals have enrolled since then. At the present time, and for the coming academic year 1944–1945, the Department of Public Health of the School of Tropical Medicine, in cooperation with the Insular Department of Health, is offering the following courses:

(*a*) *Master of Science in Public Health:* This course of study, which covers a full academic year, is designed to provide the student with an understanding of the basic principles of public health work in their practical as well as theoretical applications. The subject-matter and sequence of study is, in general, similar to that provided by universities of the United States and Europe, with the exception that here more emphasis is placed on problems incident to a tropical environment. The course is essentially a postgraduate one and open only to doctors in medicine.

(*b*) *Master in Sanitary Science:* This is a course planned to acquaint the students with the principles and practices of public health engineering adapted to tropical environments. Candidates for this course must be graduates in science or engineering. The course lasts one full year.

(*c*) *Certificate in Public Health Nursing:* This basic course in public health nursing covers a full academic year and is open to registered nurses with at least two months of field experience in public health work.

(*d*) *Certificate in Medical Technology:* This course was established to meet the pressing need for trained workers in public health and hospital laboratories. It is open only to graduates in science who show evidence of having approved courses in biology, chemistry and physics.

(*e*) *Short Courses for Sanitary Inspectors:* This is a short course designed to provide an understanding of certain elements of public health work to persons now engaged in, or intending to engage in, public health work.

In addition to the financial assistance rendered, the Insular Department of Health contributes to these courses by providing facilities for field work. It is possible to carry on field work anywhere on the island and in any of the various agencies of the government. It is routine for students to make the District Hospital or the Public Health Unit their headquarters for whatever work they have in mind. These various agencies are also open to members of the school and to visiting scientists for any research work they may care to undertake.

The courses thus offered by the school follow the general pattern utilized in similar continental schools, although they are adapted to meet the needs of tropical areas, especially those incident to Puerto Rico. Because of the many facilities available, these courses are made as objective as possible. The student spends a large portion of his time in the field, studying the problem first-hand and the application of method or methods best adapted to its solution. The Division of Health and Sanitation of the Office of the Coordinator of Inter-American Affairs is sending several students to the school, since it feels that the health problems of many of the Caribbean, Central and South American countries are likened in many ways to those found in Puerto Rico, with the added incentive that here the most up-to-date methods are applied towards their solution.

The teaching of tropical medicine has continued as heretofore, special emphasis being given to bedside teaching, teaching at the dispensary combined with practical epidemiology and field work.

In summarizing, it may be said that mutual benefits have been derived by this close association between the Insular Department of Health and the School of Tropical Medicine of the University of Puerto Rico. A unique opportunity is thus provided for the teaching of tropical medicine and public health, as well as for research in these fields.

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SPECIAL ARTICLES

THE DESTRUCTION OF COENZYME I AND COCARBOXYLASE IN SKELETAL AND CARDIAC MUSCLE AFTER DEATH

IN the course of studies of coenzyme breakdown in heart muscle after experimental coronary ligation in dogs, the idea was entertained that the amount of coenzyme breakdown after one hour of death might be considered the maximum breakdown that could be expected in that length of time following any experimental procedure. In order to test this hypothesis, six dogs (previously on a standard diet of "Pard" dog food) were anesthetized with pentobarbital sodium, the chests were opened and the hearts removed. Immediately on removal of the heart, a sample of left ventricle and a similar sample of deltoid muscle were removed, heated in boiling water for five minutes, homogenized and subsequently analyzed for cocarboxylase and coenzyme I. One hour later a second sample of each tissue was removed and treated in a similar manner. The dog and excised heart were allowed to remain at room temperature during the hour. Coenzyme I was determined by the method of Axelrod and Elvehjem,[1] as modified by Greig.[2] Cocarboxylase was determined manometrically, using split carboxylase prepared as described by Green *et al.*[3]

The results of these analyses are submitted in Tables 1 and 2.

TABLE 1

COENZYME I IN γ/GM OF DRY MUSCLE

Exp. No.	Skeletal muscle control	Skeletal muscle 1 hr. post-mortem	Per cent. change	Heart muscle control	Heart muscle 1 hr. post-mortem	Per cent. change
II 1.	2730	2650	− 2.9	3120	2150	−30.9
II 2.	2430	3380	+28.1	3180	2540	−20.1
II 3.	1649	0	−100.0	881	155	−82.5
II 4.	2640	2235	−15.1	3920	2375	−39.3
II 5.	924	783	−15.3	642	826	+28.7
II 6.	1173	1725	+47.0	2955	2610	−11.7
Average			− 9.7			−25.9

One may be impressed by the surprising lack of destruction under these conditions. Instead of finding nearly complete breakdown of cocarboxylase and coenzyme I, in the case of cocarboxylase in skeletal muscle at least, there is frequently less breakdown than was found previously in shock.[4]

[1] A. E. Axelrod and C. A. Elvehjem, *Jour. Biol. Chem.*, 131: 77, 1939.

[2] Margaret E. Greig, personal communication.

[3] D. E. Green, D. Herbert, V. Subrahmanyan, *Jour. Biol. Chem.*, 138: 327, 1941.

[4] Margaret E. Greig and Wm. M. Govier, *Jour. Pharmacol. and Exp. Therapy*, 79: 169, 1943.

TABLE 2

COCARBOXYLASE IN γ/GM OF DRY MUSCLE

Exp. No.	Skeletal muscle control	Skeletal muscle 1 hr. post-mortem	Per cent. change	Heart muscle control	Heart muscle 1 hr. post-mortem	Per cent. change
II 1.	23.7	22.5	− 3.4	55.0	61.2	+10.1
II 2.	22.8	20.3	−10.9	68.6	53.3	−22.3
II 3.	28.3	18.8	−33.6	63.9	55.0	−13.9
II 4.	21.1	14.2	−32.7	48.6	35.4	−27.1
II 5.	21.3	20.9	− 1.4	71.0	53.0	−25.4
II 6.	18.4	20.4	+ 9.8	65.8	63.3	− 3.8
Average			−12.0			−13.7

By way of explanation, one may suggest that after death the breakdown products of the coenzymes are not removed from the tissue by the circulation, and consequently by their accumulation may serve to inhibit catabolic enzymes. This explanation may be supported by work showing that thiamin inhibits yeast cocarboxylase phosphatase[5] and that nicotinamide inhibits coenzyme I nucleotidase.[6]

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AN EXPERIMENTAL METHOD FOR EVALUATING BLOOD SUBSTITUTES

REPORT ON SALINE, PLASMA, POLYVINYL ALCOHOL AND ISINGLASS

THE following conditions are desirable in an experiment designed to evaluate substances which may be used for the intravenous treatment of traumatic shock:

(1) The group of animals which is used for the test should be as nearly homogeneous as possible.

(2) The trauma should be of the same degree in each animal and easy to apply. Complicating factors such as anesthesia and hemorrhage into the injured tissues should be reduced to a minimum.

(3) The injury should be highly fatal in the control animals but mild enough to allow a proportion of the treated animals to recover. Percentage survival is considered to be the best single index of the effectiveness of treatment.

(4) The experiments should be carried out with the animals kept at a constant environmental temperature.[1]

(5) If a large number of animals can be handled at one time, there are the obvious advantages of con-

[5] H. G. K. Westenbrink, D. A. vanDorp, M. Gruber, H. Veldman, *Enzymologia*, 9: 73, 1940.

[6] P. J. G. Mann and J. H. Quastel, *Biochem. Jour.*, 35: 502, 1941.

[1] F. M. Allen, *Arch. Surg.*, 41: 155, 1939.

venience and of improving the conditions for regulating the comparison between the substances under test.

Using rats in which shock of the tourniquet type was produced by a slight adaptation of a technique described by Haist and Hamilton[2] we have found that most of these conditions can be met. The present report deals with rat plasma, 4 per cent. solutions in 0.85 per cent. saline of isinglass[3] and of polyvinyl alcohol (Type RH623 E. I. du Pont de Nemours and Company) and of 0.85 per cent. saline alone.

Ten 224–250 gm rats were used each day. Two served as controls while the remaining eight rats were divided into groups of two, each group receiving one of the solutions to be tested. A metal tourniquet which could be tightened to exert a constant pressure, was applied high on the thighs of both hind legs for five hours. Transfusion through a cannula in the right jugular vein was started forty-five minutes after release of the tourniquets. Ten cc of solution were injected into each rat at a rate of 2-2.1 cc per hour. Pentothal sodium (0.3 cc, 1 per cent. solution per 100 gm of rat given intraperitoneally) was given to permit cannulation. The anesthesia was light enough so that the effects wore off a few minutes after the cannulation was completed. Apart from this no anesthetic was used or was considered desirable for any reason throughout the experiment. Except for the 10 to 15 minutes used for the cannulation the animals were kept in thermostatically controlled warming cabinets at a temperature of 27–28° C.

The first 27 rats received unsterilized solutions. Thereafter the saline and isinglass solutions were autoclaved and the plasma and polyvinyl alcohol solution were passed through a Seitz filter. The plasma was prepared the same day as it was used from blood obtained by exsanguinating etherized rats through the carotid artery. About 10 units of heparin per cc of blood were used as an anticoagulant. The plasma was allowed to stand for several hours in the ice box and then centrifuged to remove any precipitate which had formed. The filtration was performed about two hours before the injection was started.

The results are set forth in Table 1.

TABLE 1

SURVIVAL RATES IN RATS TREATED FOR SHOCK

Substances tested	No. of animals	No. survived	Per cent. survived	Average survival time of the remainder in hours
Plasma	20	5	25	12 (range 2–38)
Saline	20	8	40	14 (range 3–33)
Isinglass	20	5	25	14 (range 2–31)
Polyvinyl alcohol	20	13	65	10 (range 4–20)
Control	25	2	8	10 (range 2–23)

Rats living more than 48 hours after the shock was initiated are considered to have "survived."

The effectiveness of polyvinyl alcohol is striking. The preparation used in this work (RH 623) has an approximate viscosity in 4 per cent. aqueous solution of 5 centipoises at 20° C. The molecular size has not been accurately worked out. Using preparation RH 391, a polyvinyl alcohol with a viscosity of 55 centipoises under the same conditions and therefore with a different molecular size, Heuper *et al.*[4] report many undesirable side effects following its parenteral administration in experimental animals. Although the toxic effects of RH 623 may be similar to those of RH 391 this should not be assumed on the basis of the work with RH 391 alone. For this reason we have undertaken to determine the toxicity of RH 623 separately. At any rate the fact that RH 623 is so effective for the immediate treatment of shock, is most interesting.

The relatively low survival rate in the group receiving plasma is worthy of comment. In accord with the findings reported here Allen[1] and Rosenthal[5] have found saline more effective than homologous plasma or serum in treating tourniquet shock in rats and mice. On the other hand, Mylon, Winternitz and de Süto-Nagy[6] working with dogs in tourniquet shock, report a 10 per cent. recovery with saline and a 76 per cent. recovery with citrated plasma. In a recent paper Green[7] states that homologous plasma did not decrease significantly the mortality in rats in tourniquet shock. It is apparent that the rating of plasma in the treatment of tourniquet shock is not clearly established.

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ASSOCIATIVE DYNAMIC EFFECTS OF PROTEIN, CARBOHYDRATE AND FAT

IN spite of published evidence warranting a different understanding, a general belief still prevails

[2] R. E. Haist and J. Hamilton, In press (personal communication).

[3] Kindly supplied by Professor N. B. Taylor, department of physiology, University of Toronto.

[4] W. C. Heuper, J. W. Landsberg and L. C. Eksridge, *Jour. Pharm. and Exper. Therap.*, 70: 201, 1940.

[5] S. M. Rosenthal, *Pub. Health Rep.*, 58: 1429, 1943.

[6] E. Mylon, M. C. Winternitz and G. J. de Süto-Nagy, *Amer. Jour. Physiol.*, 139: 313, 1943.

[7] H. N. Green, *Lancet*, ii: 148, 1943.

that the specific dynamic effects of individual nutrients are significant with reference to normal, mixed diets and that the relatively high dynamic effect of protein dominates heat production in nutritive practice.

The facts in this relation are of special present importance because of the critical situation of nutrition throughout the world; because of a characteristic rôle of fat in connection with the utilization of nutritive energy; because of the need for fat in the manufacture of explosives; and because of the increased efficiency with which fat is "skimmed off" in manufacturing processes from which by-product feeding stuffs are derived.

Significant in this connection is a series of respiration experiments conducted with albino rats as subjects, in which were determined the specific dynamic effects of protein, carbohydrate and fat, singly and in the four possible combinations of these three kinds of nutriment; all such determinations being made in comparatively long-time experiments with the heat production from complete basal diets sufficient for maintenance as the base values.

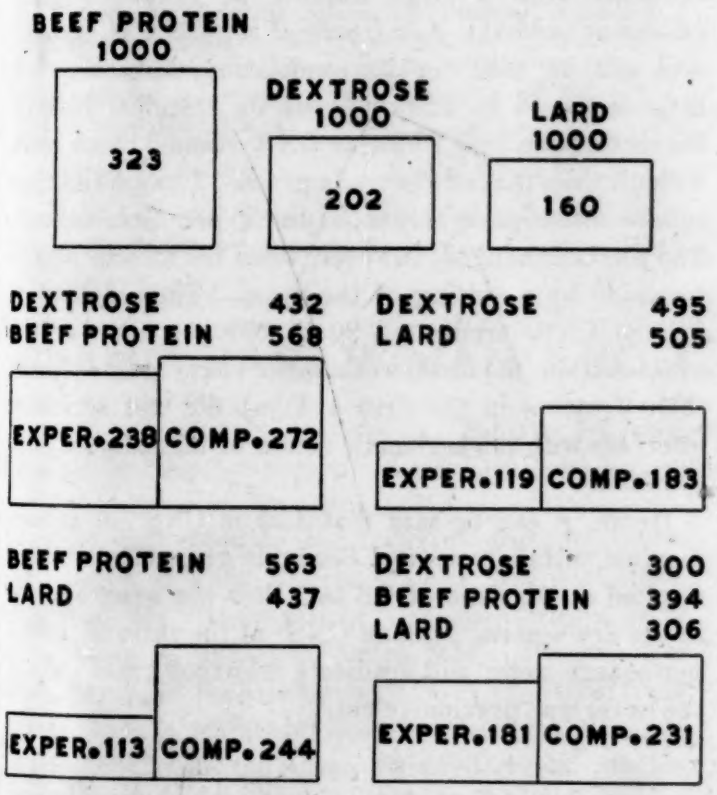

FIG. 1. Dynamic effects per thousand calories of gross energy of nutrients as affected by nutrient combination. Graph explained in text.

Twelve rats of exactly the same age were used as the subjects of each determination, the dynamic effects being measured as the difference in heat production from the basal and the supplemented diets as observed for each dietary treatment during seven-hour experimental periods on two consecutive days, the observations on the supplemented diets being made seven days after those on the basal diets.

In Fig. 1 are presented values for the dynamic effects per 1,000 calories of gross energy of the individual nutritive supplements, and similar values for the four mixed supplements (1) as directly determined and (2) as computed from the values for their individual components.

The values above the rectangles represent in each case 1,000 calories of gross energy of the individual or of the combined nutrients, and the values inside the rectangles represent the dynamic effects of these substances fed as supplements to the basal diet.

The dynamic effects of the mixed supplements following the abbreviation, "Exper.," were as determined by experiment, while those following the abbreviation, "Comp.," were computed from the experimentally determined values for the individual components; the extent to which the determined were smaller than the computed values expressing the extent to which the association of nutrients resulted in decreased energy expense of utilization.

The separately determined dynamic effects of beef protein, dextrose and lard being 32 per cent., 20 per cent. and 16 per cent., respectively, of their gross energy values, the dynamic effects of the combination of dextrose and protein was 12.5 per cent. less, of dextrose, protein and lard 22 per cent. less, of dextrose and lard 35 per cent. less, and of protein and lard 54 per cent. less, than as computed from the dynamic effects of the individual nutrients.

Lard was much more potent than was beef protein in determining dynamic effects of nutrient mixtures. It conferred economy of utilization upon the nutrient combinations in which it was present.

The dynamic effects of diets, therefore, are not the additive dynamic effects of their components, and are not dominated by their protein contents; and inasmuch as there is no means of distributive assignment of the energy values of diets among their components, there are no significant standard dynamic effects of individual nutrients.

The results of this study suggest no special reason for decreasing the protein content of diets for hot weather, but rather that any desired decrease in dynamic effect because of hot weather should be accomplished by diminishing first the carbohydrate, second the protein and last the fat of the diet.

Also the results of this study imply that manufacturing processes which decrease the fat content of by-product feeds serve to lower the net energy value of the products not only through diminishing their gross energy but also by increasing the energy expense of their utilization.

That the protein contents of diets do not dominate

the heat increment is also shown by five series of experiments conducted at this laboratory (Forbes, *et al., Jour. Nutr.*, 10 (1935), 461; 15 (1938), 285; 18 (1939), 47; 20 (1940), 47), with mature as well as with growing rats as subjects, in which the heat production of animals receiving equicaloric diets differing in protein content decreased slightly in the order of the increase in protein.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE CHEMICAL CONTROL OF BERMUDA GRASS AND OF CROWFOOT GRASS

SODIUM CHLORATE[1, 2] and cyanamide[3] have been suggested for an eradication of Bermuda grass (*Cynodon dactylon* Pers.). The compounds have been used with a varying degree of success.[4] Experiments with other herbicides seemed therefore indicated. As laboratory experiments[5] had shown that ammonium sulfamate has a high toxicity for Bermuda grass, tests at roadside plots and at a tennis court were started with this salt as well as with calcium thiocyanate, as this compound had been used successfully in the eradication of nut grass.[6]

Series of experiments were started in October, January, February, July, August and September, so as to compare the influence of the various seasons. 0.5 to 3 liters of the solution were sprinkled per square meter, which contained from 200 to 1,000 plants. The calcium thiocyanate has always been used as a solution 1.25 molar in CNS^-, while the concentration of the ammonium sulfamate varied from 0.5 to 2 molar. We are obliged to the American Cyanamide Company for the supply with calcium thiocyanate solution and to E. I. du Pont de Nemours and Company, Inc., for the ammonium sulfamate.

The control of the Bermuda grass has been completed within a week with as small an amount as 0.6 l. 1.25 m CNS^- per square meter if there was no rain in the first four days after the treatment. The plots remained free of weeds for three to six months after the treatment. However, the success of the treatment depends largely on the season. In dry weather the control was complete. If there was about 0.5 inch rain in the first few days after the application of the solution, complete control of the weed could still be reached by the use of 1 liter 1.25 m CNS^- per square meter. Heavier rains limited the eradication and could not be counteracted by higher doses of the herbicide. Also the length of time for which a complete control lasted was influenced by the rain, immigration of weeds, especially crowfoot grass (*Eleusine indica*) from neighboring plots occurred much quicker in the rainy than in dry season.

Ammonium sulfamate killed the Bermuda grass in doses of 0.6–1 liter of molar solution completely in the dry season. The control lasted from 3 to 5 months. Weaker solutions were only partially effective. The rain affected its action more than that of the calcium thiocyanate; 0.5 inch rain in the first 4 days already reduced the control to about 90 per cent., stronger rains made it rather incomplete.

Some of the plots treated with calcium thiocyanate contained also a large number of crowfoot grass (*Eleusine indica*). Ada Georgia[7] reports that carbolic acid can be used for its eradication, but otherwise little seems to be known about its chemical control. Its eradication by 1.25 molar CNS^- seemed much more difficult than that of Bermuda grass. 1 to 1.5 liter per square meter gave only a 50 to 80 per cent. control. The picture changed, however, when the treatment was preceded by a cutting of the grass. Then, 1 liter of 1.25 m CNS^- eradicated 90 to 100 per cent. of the grass within the first week, also heavy rains (more than 3 inches in the first 4 days) did not seriously interfere with the herbicidic action of the calcium thiocyanate.

Hence, it can be said that 1.25 m CNS^- or m ammonium sulfanate control Bermuda grass effectively if applied at the ratio of 0.6 to 1 liter per square meter in the dry season. 1.25 m CNS^- at the ratio of 1 liter per square meter will eradicate crowfoot grass only if the grass was previously cut.

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CAIN, STANLEY A. *Foundations of Plant Geography.* Illustrated. Pp. xiv + 556. Harper and Brothers. $5.00.

SANDELL, E. B. *Colorimetric Determination of Traces of Metals.* Illustrated. Pp. xvi + 487. Interscience Publishers. $7.00.